recent years, the circular on the practical use of meteorological reports and weather-maps (issued by the signal-service, 1871), and the appendices on the relation of rain and winds, and on the course of storms in the different months, in the signal-service reports for 1878 and 1874.

(*To be concluded.*)

THE INTELLIGENCE OF BATRACHIANS.

IN his recent volume on Animal intelligence,[1] Mr. Romanes devotes less than two pages to the intelligence of batrachians. He remarks, 'On the intelligence of frogs and toads very little has to be said.' That our author should have included toads in the above seems strange; as instances of cunning, and proofs of the general intelligence, of these animals, are numerous. In conversation with practical observers of animal life, I have never yet found one that did not accord a marked degree of intelligence to toads. In short, toads may readily be tamed, will come when called, and have been seen to place matter attractive to flies, their principal food, near their hiding-places, so they could remain at home and at the same time be sure of a sufficiency of food. This evidence of foresight, on the part of toads, is no uncommon occurrence, and quite effectually establishes their claim to a creditable degree of intelligence.

Of the spade-foot or hermit toad (Scaphiopus solitarius) and the tree-toad (Hyla versicolor) I have but little to record. The former is but rarely seen, and I have had no opportunity to experiment with it with a view to testing its mental capabilities. The habits of the animal, as described by Agassiz and Putnam, would lead one to conclude that intellectually they are to be classed with the common toad. The tree-toad, or Hyla, being crepuscular in habits, was found difficult to study, and nothing was determined that bore upon the question of its intellectual capacity. I can but state my impression, which is, that they are not so cunning as the common toad.

On the other hand, I am pained to confess that my many observations and experiments with the several species of true frogs found here, conducted without an intermission for four months, have yielded but little evidence that these creatures possess a particle of intelligence. It almost proved, indeed, to be labor lost, —

> 'To perch upon a slippery log,
> And sit in judgment on a frog.'

[1] Animal intelligence. By George J. Romanes. (Internat. sc. series, no. xliv.) New York, *Appleton & Co.*

Mr. Romanes remarks, that, if frogs are removed to a long distance from water, they will take the shortest route to the nearest pool or brook. Even this, I find, is only usually true. Quite ten per cent of such 'removed' frogs started off, when released, in the direction of the most distant water, rather than that which was nearest. One of my many experiments was as follows: I placed a pail filled with water in a dry, dusty field, burying it to the brim. It was protected by a cap of coarse wire sieving. I then liberated a frog within twenty yards of it. It hopped in the opposite direction, towards water nearly three hundred yards distant. I then placed a frog on the opposite side of the buried pail, so that the distant brook could only be approached by passing near or directly over it, if the frog took a direct course. This the frog did, and less than a score of leaps brought it to the water covered by the sieve. It seemed quite satisfied with the fact that a little water was in sight, although out of reach. Here the frog remained until morning. The following day I removed the pail, and buried it within fifty yards of a running brook. I then took seven frogs of three species, and placed them upon the sieve, which was about half an inch above the surface of the water. Here five of them remained during the whole day, exposed to the glare and heat of a cloudless midsummer day. The evaporation from the water beneath them barely kept them alive; and yet within so short a distance was a running brook, with all the attractive features of ideal frog-life.

I repeated this experiment, with slight modifications, several times, and always with essentially the same results.

In his Travels in North America (Eng. trans., vol. ii. p. 171), Peter Kalm refers to certain habits of the bull-frog (Rana Catesbyana) which seemed to indicate that the frogs of this species occupying the same pond were somewhat governed by a leader. His remarks are, "When many of them croak together, they make an enormous noise. . . . They croak all together, then stop a little, and begin again. It seems as if they had a captain among them: for, when he begins to croak, all the others follow; and, when he stops, the others are silent;" and he adds that the 'captain' apparently gives a signal for them to stop. This, if true, would be evidence of considerable intelligence; but it is only apparently true of them. I have very carefully watched the bull-frogs in a pond near my house, and have found that the croaking of the 'captain' is not always that of the same individual. At times

the initial croak would come from one side of the pond, then the other, and so continue to vary. This shows at once that not any one individual started and stopped the croaking of its companions.

Hoping to find that in the pursuit of prey, which is principally insects, frogs would display some intelligence, I tried several experiments to test their ingenuity; but it was of no avail. Unless the food could be easily reached by making the simple exertion of a single leap, the frogs would go hungry. Subsequently I placed a large fly upon a piece of thin mica, and surrounded it with a circle of fine needles, piercing the plate. The fly thus protected could only be seized by the frog suffering a severe pricking of the jaws. This, I found, a frog would suffer indefinitely, in its attempts to secure the fly. In one instance, the frog, which had been fasting for seventy-two hours, continued to snap at the needle-protected fly until it had entirely skinned its upper jaw. I concluded from this, that the wits of a frog were too limited to be demonstrated.

Some weeks after having completed these experiments, I had the good fortune to capture two fully grown specimens of the bull-frog (Rana Catesbyana); and, noticing their enormously distended sides, I examined the stomach-contents of the two. In one was a full-grown chipmunk (Tamias striata); in the other, a garter-snake (Eutania sirtalis) measuring eighteen inches in length, and also a field-mouse (Arvicola riparia). On close examination, I found that the snake had partially swallowed the mouse; and, while thus helpless, the frog had evidently attacked the snake, and swallowed it.

It is evident, I think, that the frog recognized the helpless condition of the snake at the time, and took advantage of it. If so, it is evidence of a degree of intelligence, on the part of the frog, which the results of my experiments on the frogs generally, had not led me to expect. Certainly a frog, however large, will not attack even a small snake if it is possessed of its usual activity.

The salamanders, on the other hand, by their active movements, wandering disposition, quickness of hearing, and other minor characteristics, give evidence of greater intelligence. This I can state of them, however, as an impression only; for my efforts to prove them possessed of cunning were not successful. The purple salamander, it is true, fights when captured, curving its back, and snapping viciously. This no frog ever does. The common spotted triton (Diemyctelus) becomes quite tame when kept in an aquarium, and, as I found, is soon able to determine the difference between a fly held against the glass and one held over the water. I frequently held a fly against the glass, and very near the triton; but it took no notice of it, after one or two efforts to seize it, but would follow my hand, and, when the fly was held over the surface of the water, the triton promptly leaped at and seized it. This is, indeed, but meagre proof of intelligence, but seems to show, I think, that a salamander is more cunning than a frog.

My observations lead me to conclude, that the habits of an animal have much, if not all, to do with the intellectual capacity it possesses. Frogs, as a class, are not migratory. They frequent a given pond or stream; and, sustained by the insect-life that comes to them but is not sought, they pass an eventless life, trusting, as it were, to luck. Such an existence requires no intellectual exertion, and none is made. The salamanders, on the contrary, are far more wandering and active. They appear to be ever in search of food, and, when lying in wait for it, choose such positions as experience has taught them are best adapted for the purpose: at least, my studies of such specimens as I have kept in confinement lead me to believe so. Intellectually, therefore, the salamanders are in advance of the frogs; but the batrachians as a class, although higher in the scale of life than fishes, are, I believe, inferior to them in intelligence.

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THE PONS-BROOKS COMET.

THE comet which is now being observed at its first predicted return was discovered by Pons, at Marseilles, two hours after midnight of July 20, 1812. Pons was at the time *concierge* at the Marseilles observatory, but afterwards became its director. He died in Florence, Oct. 14, 1831, at the age of seventy, having, between the years 1801 and 1827, discovered no less than thirty-seven comets; this one, according to Zach (*Monatl. corr.*, xxvi. 270), the sixteenth in ten years.

Pons describes the comet at the time of discovery as an irregular, nebulous mass, without coma or tail, and invisible to the naked eye. Having made sure, from the motion, that it was really a comet, he announced his discovery on July 22; and, from July 25 to Aug. 3, it was bright enough to be observed, at lower culmination, with the Marseilles in-